MODIS DATA STUDY
TEAM PRESENTATION

October 26, 1990

AGENDA

1. Action Items
2. Plan for Assessing MODIS Anchor Point Requirements
3. MODIS Level-1 Processing Context Diagram
4. MODIS Level-1 Processing Global Environmental Model

ACTION ITEMS

10/5/90-2 [Doug Hoyt]: Examine MCST documentation and identify missing or additional information items that the MODIS Data Study Team will need to complete the specification of MODIS calibration processing. STATUS: Presentation given at 10/19/90 meeting. Closed.

10/12/90-1 [John Blaisdell]: Investigate alternative Earth shape models that are potentially useful for MODIS geolocation activities, investigate typical applications of the various alternatives, determine the names of investigators who use the various models, and generate a written report of findings. STATUS: Report given at 10/19/90 meeting. Closed.

10/12/90-2 [Watson Gregg]: Prepare a report on MODIS anchor point requirements. Analyze the utility of alternative parameters to describe MODIS observation geometry, the solar illumination, and lunar position (perhaps required for calibration) at each pixel location and determine the specific angular parameters required to completely specify the geometry of each observation. Determine which items are available from sources external to MODIS processing and which items will need to be computed within the MODIS processing. STATUS: Open.

10/19/90-1 [John Blaisdell]: Expand introductory material in Earth Model write-up to include broad discussion of MODIS geolocation and need for Earth model. Coordinate with Al Fleig to distribute report. STATUS: Open.

PLAN FOR ASSESSING
MODIS ANCHOR POINT REQUIREMENTS

Definition: Anchor points are subsets of the total pixels in a given observation increment (granule) where navigation parameters are directly computed. The parameters determined at these anchor points may be interpolated to provide parameters for the entire observation increment.

Purpose: To reduce the size of archived data and the number of computations required for data processing. The anchor point method was used for CZCS processing.

Method of Analysis: Earth location will be computed using an oblate spheroid Earth model (Clarke, 1866). Geodetic Earth position will be computed. All pixels for MODIS-N and MODIS-T will be georeferenced, and various anchor point strategies compared to this reference in terms of accuracy, data size, and number of computations.

Analyses will be performed for MODIS-N high resolution pixels (250 m) and low resolution pixels (1000 m). MODIS-T analyses will involve a zero-tilt case and a maximum (50 deg.) tilt case.

Six navigation parameters will be observed in the analyses: latitude, longitude, solar zenith angle, solar azimuth angle, spacecraft zenith angle, and spacecraft azimuth angle.

The anchor point strategies to be tested will include:

-- No. anchor points = 10% of pixels in a scan
5%
1%
(CZCS anchor points were 3.9% of total)

-- Anchor point distributions to be examined are 1) uniform (equal pixel spacing between anchor points) and 2) non-uniform (unequal pixel spacing). (CZCS was non-uniform).

-- Two interpolation methods: 1) linear 2) cubic (CZCS was cubic).

All analyses will be performed for a single scan at the equator.

Analysis: Analysis will require the production of tables showing maximum error in the six parameters, data volume savings, and computation savings. Tables will be constructed in the manner shown below. There will be 6 total tables: 3 tables of maximum error, data savings and computations savings for a linear interpolation method, and 3 each for a cubic interpolation method.

Results: Results should suggest ways in which data storage may be optimized and computations reduced in return for reduced Earth location accuracy. It should facilitate decisions on the limits of this reduced accuracy as a trade-off for reduced storage and computational requirements. The study is not designed to determine the optimum anchor point strategy, but rather its advantages and trade-offs, and to aid in a possible follow-on study to best determine the actual anchor point locations, if this method is adopted for MODIS.

MAXIMUM ERROR												
	LINEAR						CUBIC					
	Ψ	Φ	θ_o	ϕ_o	θ	ϕ	Ψ	Φ	θ_o	ϕ_o	θ	ϕ
UNIFORM 10%												
UNIFORM 5%												
UNIFORM 1%												
NON-UNIFORM 10%												
NON-UNIFORM 5%												
NON-UNIFORM 1%												

Ψ = latitude

Φ = longitude

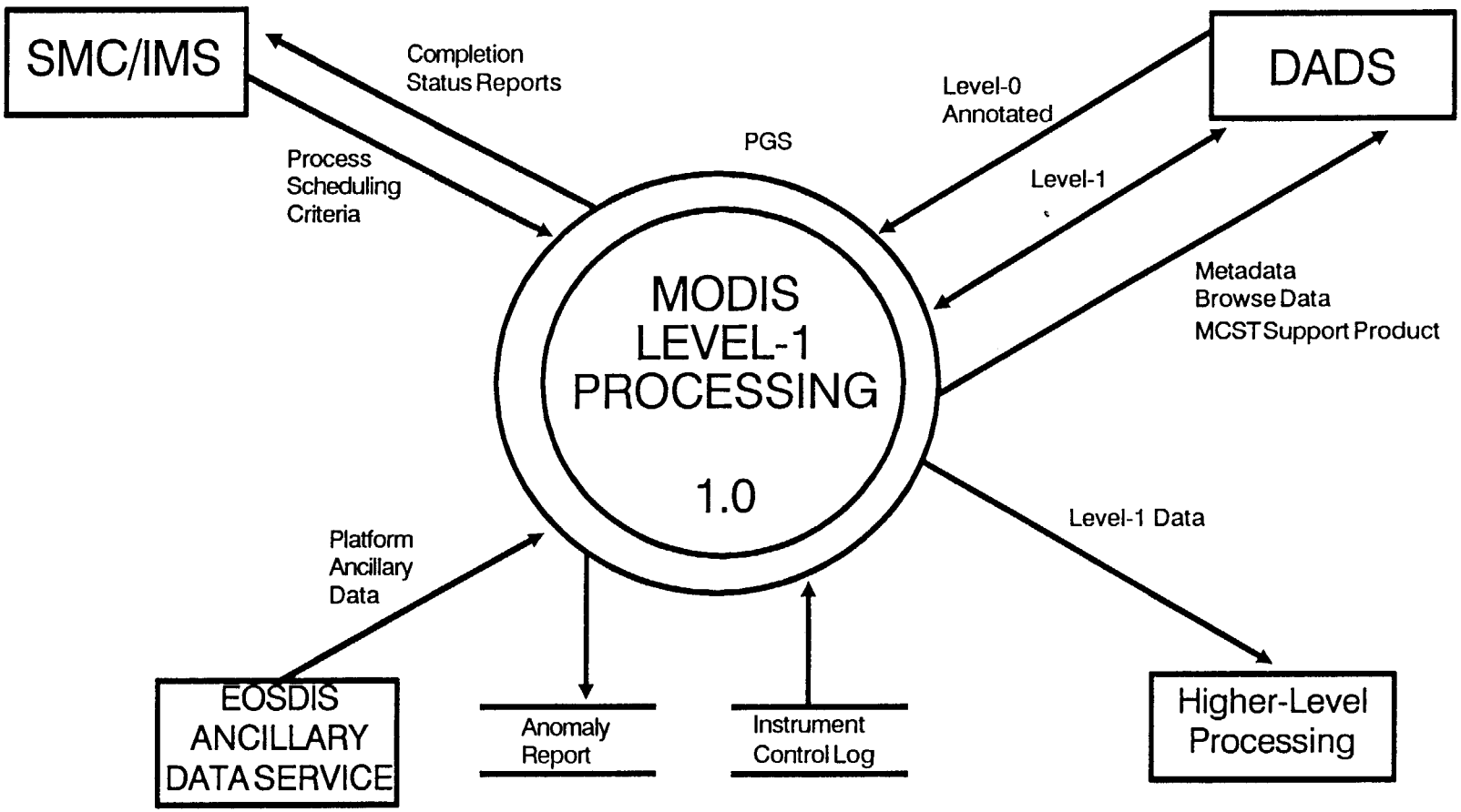
θ_o = solar zenith angle

ϕ_o = solar azimuth angle

θ = spacecraft zenith angle

ϕ = spacecraft azimuth angle

MODIS LEVEL-1 PROCESSING
CONTEXT DIAGRAM



MODIS LEVEL-1 PROCESSING REQUIREMENTS
PRELIMINARY

REFERENCES

1. MODIS Level-1 Data Product Requirements, July, 1988

2. HIRIS and MODIS Ground Data Systems: Functional Requirements, Level-1, Preliminary, Version 1.0, December 16, 1988

3. MIDACS Level-II Functional Requirements, December, 1988

4. MODIS Data System Data Requirements Document, April, 1989

5. EOSDIS Level-I Requirements, Rev. C, June 15, 1989

6. EOSDIS Level-II Requirements, Rev. A, June 15, 1989

7. CDOS Requirements Specification, Level-III, Pre-Release, August 31, 1990

8. Preliminary MODIS Level-1 Processing System Design, First Draft, September 12, 1990

9. Functional and Performance Requirements Specification for ECS, Fourth Preliminary, September 14, 1990

10. Prespecification Descriptions of MODIS Level-1 Processing, September 21, 1990

GLOBAL ENVIRONMENTAL MODEL--REQUIREMENTS

1. MODIS Level-1 processing shall generate Earth-located calibrated scenes with all appropriate header information in a form to be delivered to the DADS.

2. MODIS Level-1 processing shall reprocess Earth-located calibrated scenes with substitute algorithms without requiring retransmission of data from CDOS.

3. MODIS Level-1 processing shall generate Metadata products describing the contents of individual MODIS data granules and deliver the metadata to DADS.

4. MODIS Level-1 processing shall generate and deliver browse data to the DADS to enable users to examine a spectrally/spatially/dynamically truncated subset of the actual data.

5. MODIS processing shall provide a status report on product generation to the PGS, which shall receive the information and route a production status report to the Information Management System.

6. MODIS Level-1 processing shall generate data anomaly reports for ICC detailing any unexpected or potentially serious spacecraft status.

7. MODIS Level-1 processing shall generate and provide to IMS DQA reports to enable data product/algorithm originators to monitor and validate the product.

8. MODIS Level-1 processing shall generate MODIS characterization support products and deliver to the DADS with the same timeliness as the standard product.

9. MODIS Level-1 processing shall be accomplished using two distinct sets of stand-alone software: one set to support MODIS-N processing and one set to support MODIS-T processing.

10. Level-1 processing of MODIS data shall be completed within 24 hours of all input data sets becoming available, not including time for human intervention (approximately 48 hours after data acquisition at the instrument).

11. MODIS Level-1 processing shall be accomplished using the software facilities, hardware, and peripheral support facilities provided for the PGS.

12. MODIS Level-1 processing shall append Platform Ancillary Data and other ancillary data essential to the generation of navigated at-satellite radiances to the instrument data.

13. Level-1 Data granule boundaries shall be established on the basis of data acquisition times based on orbit position, and complete scans of data that would span granule boundaries shall be associated with the data granule that is closest overall to the acquisition times for that scan.

14. The MODIS Level-1 processing shall coordinate with the GSFC ICC and EOC to monitor the consistency of the Instrument Control Logs for the MODIS instruments (MODIS Historical Data) and instrument status, radiometric, and engineering information imbedded in the received data stream.

15. The MODIS Level-1 processing shall coordinate with the GSFC ICC and EOC to assess the quality of received MODIS data and derived Level-1 data products.

16. MODIS Level-1 processing shall include data integrity checks to minimize the likelihood that incomplete, contaminated or erroneously-labeled input data items are processed.

17. Finished MODIS products shall be delivered (to the Product Management Service of the PGS) for quality assessment and, after release, to the DADS for storage and potential distribution.

18. MODIS Level-1 processing shall provide the PGS with an initial, and as needed, an updated list of input data items required to complete the processing of each individual MODIS Level-1 product.

19. The PGS shall obtain all data input items required for MODIS Level-1 processing from the collocated DADS.

20. MODIS Level-1 processing shall be capable of producing products from out-of-sequence data when the out-of-sequence condition of the input data is indicated by an out-of-sequence flag attached to the data.

21. MODIS processing shall support an interface to an EOSDIS science product task generator that generates a queue of MODIS and other instrument processing tasks for which all required data has been received or for which all needed data has not been received, but which nevertheless must be processed to meet product timeliness constraints.

22. MODIS processing shall support an interface to an EOSDIS task scheduler which examines the task queue and selects processing tasks for execution based on assigned task priorities, product timeliness constraints, the criticality of the associated product in the timely production of other products, availability of required temporary data storage facilities, etc.

23. Use of the processor and support facilities is coordinated by the Local System Management, which manages the local DAAC, and indirectly (i.e. through the direction of the Local System Management), by the System Management Center, which provides coordination in matters affecting more that one DAAC or processing center.

GLOBAL ENVIRONMENTAL MODEL--QUESTIONS

1. Will Level-1 data granules (scenes) be defined solely on the basis of time/orbit position, or will there be alternative scene definitions based on viewing location and operating mode?

LEVEL-1A PROCESSING--REQUIREMENTS

1. MODIS Level-1A processing shall perform reprocessing with substitute algorithms without requiring retransmission of data from CDOS.

2. MODIS Level-1A processing shall generate Metadata products describing the contents of individual MODIS data granules.

3. MODIS Level-1A processing shall not generate browse data.

4. MODIS Level-1A processing shall generate processing status reports.

5. MODIS Level-1A processing shall generate MODIS characterization support products and deliver to the DADS with the same timeliness as the standard product.

6. MODIS Level-1A processing shall be accomplished using two distinct sets of stand-alone software: one set to support MODIS-N processing and one set to support MODIS-T processing.

7. Level-1A processing of MODIS data shall be completed within 24 hours of all input data sets becoming available, not including time for human intervention (approximately 48 hours after data acquisition at the instrument).

8. MODIS Level-1A processing shall be accomplished using the software facilities, hardware, and peripheral support facilities provided for the PGS.

9. MODIS Level-1A processing shall append Platform Ancillary Data and other ancillary data essential to the generation of navigated at-satellite radiances to the instrument data.

10. Level-1A Data granule boundaries for shall be established on the basis of data acquisition times based on orbit position.

11. The MODIS Level-1A processing shall coordinate with the GSFC ICC and EOC to monitor the completeness of the received Level-0 data stream based upon of the Instrument Control Logs for the MODIS instruments (MODIS Historical Data) and the received Level-0 data. When received data deficiencies are identified, a data deficiency report shall be generated and a retransmission of the missing or garbled data item shall be requested.

12. MODIS Level-1A processing shall include data integrity checks to minimize the likelihood that incomplete, contaminated or erroneously-labeled input data items are processed.

13. A permanent record of received MODIS data as originally generated by the MODIS instruments (Level-0) shall be retained, or shall be recoverable from retained products, to support the reprocessing of MODIS data products and to support innovative or special-purpose analysis of received instrument data.

14. Platform Ancillary Data and other ancillary data essential to the generation of navigated at-satellite radiances from received instrument data shall be appended to the instrument data to provide a single permanent record of information essential for Level-1B processing.

15. MODIS Level-1A processing shall provide the PGS with an initial, and as needed, an updated list of input data items required to complete processing.

16. MODIS Level-1A processing shall be capable of producing products from out-of-sequence Level-0 data when the out-of-sequence condition of the input data is indicated by an out-of-sequence flag attached to the data.

LEVEL-1A PROCESSING--QUESTIONS

1. What Level-1A metadata is required?

2. Should MODIS Level-1A processing generate browse data?

3. Should one interpret the 24 hour timeliness requirement as applying to Levels-1A and -1B jointly, or individually?

LEVEL-1B PROCESSING--REQUIREMENTS

1. MODIS Level-1B processing shall generate Earth-located calibrated scenes with all appropriate header information in a form to be delivered to the DADS.

2. MODIS Level-1B processing shall reprocess Earth-located calibrated scenes with substitute algorithms in an identical manner as first-time processing.

3. MODIS Level-1B processing shall generate Metadata products describing the contents of individual Level-1B data granules and deliver the metadata to DADS.

4. MODIS Level-1B processing shall generate and deliver browse data to the DADS to enable users to examine a spectrally/spatially/dynamically truncated subset of the actual data.

5. MODIS Level-1B processing shall generate Level-1B processing status reports.

6. MODIS Level-1B processing shall generate data anomaly reports for ICC detailing any unexpected or potentially serious spacecraft status.

7. MODIS Level-1B processing shall generate navigation and calibration DQA reports, and instrument operations reports.

8. Only the on-Earth portions of each scan shall be incorporated into the Level-1B product.

9. MODIS Level-1B processing shall generate a Level-1B MODIS characterization support product; this product will contain, at a minimum, all off-Earth data not put on the standard Level-1B product, as well as other requested information.

10. MODIS Level-1B processing shall be accomplished using two distinct sets of stand-alone software: one set to support MODIS-N processing and one set to support MODIS-T processing.

11. Level-1B processing of MODIS data shall be completed within 24 hours of all input data sets becoming available, not including time for human intervention (approximately 48 hours after data acquisition at the instrument).

12. MODIS Level-1B processing shall be accomplished using the software facilities, hardware, and peripheral support facilities provided for the PGS.

13. Level-1B data granule boundaries shall be established on the basis of data acquisition times based on orbit position.

14. The MODIS Level-1B processing shall coordinate with the GSFC ICC and EOC to monitor the consistency of the Instrument Control Logs for the MODIS instruments (MODIS Historical Data) and instrument status, radiometric, and engineering information imbedded in the received data stream.

15. The MODIS Level-1B processing shall coordinate with the GSFC ICC and EOC to assess the quality of received MODIS data and derived Level-1B data products.

16. MODIS Level-1B processing shall receive Level-1A data and shall include data integrity checks to minimize the likelihood that incomplete, contaminated or erroneously-labeled input data items are processed.

17. MODIS Level-1B processing shall extract from Level-1A data processed platform ancillary data, mirror angle encoders, and other MODIS instrument data as required and navigate anchor points to the Earth geoid.

18. MODIS Level-1B processing shall not consider the surface topography in navigating the measurements.

19. MODIS Level-1B processing shall extract from Level-1A data digitized "count" data from the MODIS sensor elements and instrument engineering data and generate at-satllite radiances in absolute physical units.

20. MODIS Level-1B processing shall receive calibration parameters from the MCST and utilize these parameters in performing the counts to radiance conversion.

21. To the extent operationally possible, MODIS Level-1B processing shall include a running evaluation of MODIS instrument performance and shall evaluate the effect of instrument performance deviations on acquired Earth data quality.

22. MODIS Level-1B processing shall provide the PGS with an initial, and as needed, an updated list of input data items required to complete processing.

23. MODIS Level-1B processing shall be capable of producing products from out-of-sequence Level-1A data when the out-of-sequence condition of the input data is indicated by an out-of-sequence flag attached to the data.

LEVEL-1B PROCESSING--QUESTIONS

1. What Earth ellipsoid or geoid should MODIS Level-1 processing use for anchor-point navigation?

2. Is is OK that the MODIS Level-1B processing will not consider the surface topography in navigating the measurements?

3. Is it OK that only anchor points will be navigated, and not every IFOV?

4. Should MODIS Level-1B reprocessing occur in an identical manner as first-time processing, or should only the affected items (e.g., calibration and version number but not navigation) be recomputed?

5. Should MODIS Level-1B processing generate and deliver browse data to the DADS, and if so, how should the browse product(s) defined?

6. Sould Level-1B browse products have a different format for different MODIS operating modes (particularly MODIS-T)?

7. Will MODIS Level-1B processing produce products from out-of-sequence Level-1A data, or will Level-1B processing be suspended until the Level-1A data is in sequence?